

How Reliable Is Science?

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Abstract

During the last decade, there has been an emergence of isolated scientific studies that have been selectively cited to support claims apparently contradicting the broader evidence base, thus opening the door for scepticism on the one hand and “evidence-based” conspiracies on the other. This dangerous development in science and its wider perception within the population have been facilitated by the rapid growth and digital discoverability of the scientific literature, making it easier to search selectively for the publications that lend support to any, and often the most bizarre, hypotheses. This bias of selective reading of literature constitutes a major challenge for modern science and scientific communication. AI-based tools may help broaden evidence retrieval, yet their outputs require transparent validation and expert oversight to minimise selection bias and to ensure reliable interpretation.

Keywords: alternative facts; bias; contradictions; mosaic of discoveries; scientific method; selective reading; truth; validity

1. Scientific Findings and Alternative Facts

As the canteens of most universities tend to be closed on Saturdays and Sundays, I recently spent an entire Saturday with eco-activists in the hope of a free lunch and a stimulating debate on the apparent dangers of electromagnetic waves and modern-day mobile communications. For me, as a chemist, most of the arguments floated there at first sounded somewhat bizarre, similar to the taste of the food served during the lunchbreak, yet after listening for a while to some of the more eminent electromagnetic wave sceptics, their arguments and literature, I actually became rather concerned. Not so much that I may be in immediate danger because of my carefully hidden smartphone, yet more about the fact that the scientific literature is full of publications that may support almost any reasonable hypothesis you put forward. In other words, just take your time and search hard enough and you may find scientific evidence for almost anything!

For someone who believes in scientific rigour, this may come as a surprise and turn out to be rather shocking. Does this mean that science is unreliable, even arbitrary, as some sceptics claim these days? Are some of the studies in the literature misleading or even fake, or just of low quality and found in equally low-quality journals? Or is it not so much about the literature itself, yet about how we subjectively, and mostly selectively, view it?

Indeed, the problem at hand touches our understanding of science and the scientific process in itself. The idea that science can depict reality objectively “as it is” has long been given up, at least by philosophers of science. Science simply cannot capture a perfect holistic image of an objective and thus authoritative reality—and it is not even supposed to do so. Rather, scientists construct their own focussed models of reality, bit by bit, and thanks to this very human endeavour and numerous subjective efforts, science itself is evolving in



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time like a mosaic, with ever more sophisticated tools and at ever increasing resolution. Yet this reconstruction of our own “mosaic of reality” occurs selectively, depending on which aspect is of—subjective—interest and which one is not, in essence depending on where you stand on the mosaic and at which angle you look at it. Thus, science is not arbitrary per se; still, it is open to an arbitrary, subjective and individual selection of specific pieces of evidence. If you search exclusively for the studies reporting the potential dangers of electromagnetic waves, for instance, then you may find some studies on this topic yet miss out on an overwhelming body of evidence demonstrating their safety and exposure-specific risk assessments. This does not mean that these different bodies of evidence belong to “alternative sciences” or that they constitute “alternative facts”. It simply means that there are alternatives in searching and that, in essence, you may also find what you are looking for. This is called a subjective bias, or in modern-day slang, living in a bubble. Good scientists need to be aware of this and ideally consider both corroborating and contradictory evidence and weigh them according to study design, risk of bias, reproducibility, consistency and relevance. They need to decide which evidence to follow up and which to take with a pinch of salt or even ignore for the time being, a decision-making task possibly guided in the future by adequate AI tools. And scientists need to communicate this to the wider public, who, thanks to open access, have greater access to a plethora of literature yet may not be able to search and evaluate it appropriately.

Learning on that aforementioned afternoon from an eminent colleague that insect antennae may start to vibrate because their lengths are similar to the wavelengths of microwaves, for instance, was quite astonishing, yet also made me rather worried. Such observations require careful interpretation and should not be taken, by themselves, as evidence of behavioural effects or harm under realistic environmental exposure conditions. Still, I had seen people being chased and stung by herds of disoriented wasps before and decided to leave early. Some things one simply does not want to know, even if they are in the literature.

2. The Feature Papers Editors Collection 2025 Special Issue

This 2025 collection contains nine excellent publications that are definitely worth knowing, especially since some of them also deal with bees rather than wasps, grapevine and other stingy issues. Indeed, in their systematic review on such insects, Pg Abas and colleagues consider the use of modern technologies in precision beekeeping, an issue close to the heart of anyone who loves honey for breakfast [1]. Similarly, viral infections in grapevine are a major issue for lovers of grape juice, wine and vinegar alike, and innovative treatment methods for the Kober 5 BB grapevine micro-clones are described by Anastasiya Bilyk and her colleagues [2]. Staying in the field of bioactive agents, antifungals are the hot topic of the article by Elena Efremenko and colleagues, who, in this context, consider the application of fungal cell wall-degrading enzymes [3]. Enzymes and bacteria also play a role in the utilisation of protein-rich agricultural residues, the subject of an article by Anja Kuenz and colleagues [4]. Indeed, the production of green substances is a central theme of this collection, as Carlos Arrieta and colleagues consider ways to produce green hydrogen and Teresa Regina and Elisa Calabrese develop and apply DNA-based tools to authenticate marketed sage (*Salvia officinalis*) products [5,6]. The origin and composition of such herbs and mixtures is indeed often a complex issue, and DNA-based tools may provide a fast and efficient way of authentication. Sage is especially interesting as it is often also used for oral hygiene; this brings us to the rather interesting article by Roger Wong and colleagues on smoking and permanent tooth removal in the United States [7]. Staying with human health, Giacomo Visioli and his colleagues review lessons from ophthalmology in preventing wrong-site errors in paired-organ surgery [8]. Last but not least, the collection

also features an article by Elena Bykova and Vera Voronetskaya on a compensation strategy for the negative impacts of infrastructure facilities on land use [9].

3. Concluding Remarks

The nine feature papers presented here cover a wide range of scientific disciplines and deliver new insights into very different scientific topics and disciplines. Some of them may be of interest to biologists, others to urban planning, and yet others to hydrogen engineers and beekeepers. In any case, each of them provides impetus into its respective field of research and drives new innovations. Such a publication is not an alternative to other facts, rather a companion, and although it can be read and discussed in isolation, it must also be seen as a small stone in the larger mosaic of modern science. There are no alternative facts, just like there is no free lunch either.

Conflicts of Interest: The authors declare no conflict of interest.

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